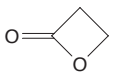
β-Propiolactone

CAS No. 57-57-8

Reasonably anticipated to be a human carcinogen

First listed in the *Second Annual Report on Carcinogens* (1981)



Carcinogenicity

β-Propiolactone is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in experimental animals.

Cancer Studies in Experimental Animals

β-Propiolactone caused tumors in two rodent species, at several different tissue sites, and by several different routes of exposure. Oral exposure to β-propiolactone caused cancer of the forestomach (squamous-cell carcinoma) in female rats, and dermal exposure caused benign and malignant skin tumors (papilloma that changed to squamous-cell carcinoma) in mice of unspecified sex. Subcutaneous injection of β-propiolactone caused cancer at the injection site in mice of unspecified sex (fibrosarcoma, adenocarcinoma, and squamous-cell carcinoma) and in rats of both sexes (sarcoma) (IARC 1974). In nursing mice, a single intraperitoneal injection of β-propiolactone caused lymphoma in both sexes and liver tumors (hepatocellular tumors) in males.

Since β-propiolactone was listed in the *Second Annual Report on Carcinogens,* additional studies in experimental animals have been identified. In female mice, oral exposure to β-propiolactone increased the combined incidence of benign and malignant tumors of the forestomach (papilloma and carcinoma) (Hochalter *et al.* 1988, Wattenberg *et al.* 1983, 1987). In male rats, intrarectal administration of β-propiolactone caused benign colon tumors (adenomatous polyps) (Hochalter *et al.* 1988), and inhalation exposure to β-propiolactone caused cancer of the nasal cavity (Sellakumar *et al.* 1987, Snyder *et al.* 1986).

Cancer Studies in Humans

No epidemiological studies were identified that evaluated the relationship between human cancer and exposure specifically to β-propiolactone.

Properties

β-Propiolactone is a colorless liquid with a pungent, slightly sweet odor at room temperature (Akron 2009). It is soluble in water, miscible with alcohol, acetone, ether, and chloroform, and probably miscible with most polar organic solvents and lipids (HSDB 2009). It is unstable at room temperature, but stable when stored at 5°C in glass containers (Akron 2009). Physical and chemical properties of β-propiolactone are listed in the following table.

Property	Information
Molecular weight	72.1[a]
Specific gravity	1.146 at 20°C/4°C[a]
Melting point	–33.4°C[a]
Boiling point	61°C at 20 mm Hg[a]
Log K_{ow}	0.462[a]
Water solubility	370 g/L at 25°C[a]
Vapor pressure	3.4 mm Hg at 25°C[b]
Vapor density relative to air	2.5[a]

Sources: [a]HSDB 2009, [b]ChemIDplus 2009.

Use

β-Propiolactone was once a commercially important industrial chemical, and more than 85% of the β-propiolactone produced in the United States was used captively to manufacture acrylic acid and esters (IARC 1974, HSDB 2009). However, β-propiolactone has been replaced in newer manufacturing methods (Bauer 2003). β-Propiolactone has been used to sterilize blood plasma, vaccines, tissue grafts, surgical instruments, and enzymes; as a vapor-phase disinfectant in enclosed spaces; and in organic synthesis (IARC 1974). It has been used as a sporicide against vegetative bacteria, pathogenic fungi, and viruses (HSDB 2009). β-Propiolactone has also been used to inactivate viruses for use in vaccines for animals and humans (Levy *et al.* 1975, Parker 1975, Kurogi *et al.* 1978, Scheidler *et al.* 1998).

Production

β-Propiolactone was first produced commercially in the United States in 1958, and one U.S. company produced β-propiolactone from 1958 until at least 1973 (IARC 1974). U.S. production was approximately 22 million kilograms (48.5 million pounds) in 1972, but less than 454 kg (1,000 lb) in 1975 (HSDB 2009). No data on current production of β-propiolactone were found. In 2009, β-propiolactone was produced by one manufacturer, in Europe (SRI 2009), and was available from twelve suppliers, including seven U.S. suppliers (ChemSources 2009). No data on U.S. imports or exports of β-propiolactone were found.

Exposure

Because β-propiolactone is no longer used as a sterilant in medical procedures or in food, the potential for exposure of the general population is limited (HSDB 2009). Potential exposure to waste effluents from production and manufacturing plants is minimal, because of β-propiolactone's short half-life in water (IARC 1974). Occupational exposure may occur by inhalation and dermal contact at industrial facilities where β-propiolactone is used as a chemical intermediate. Occupational exposure may also occur in laboratories where it is used to inactivate viruses for research and vaccine applications. The National Occupational Hazard Survey (conducted from 1972 to 1974) estimated that 575 workers potentially were exposed to β-propiolactone (NIOSH 1976). No more recent exposure estimates were found.

Regulations

Environmental Protection Agency (EPA)

Clean Air Act

National Exposure Standards for Hazardous Air Pollutants: Listed as a hazardous air pollutant.

Comprehensive Environmental Response, Compensation, and Liability Act

Reportable quantity (RQ) = 10 lb.

Emergency Planning and Community Right-To-Know Act

Toxics Release Inventory: Listed substance subject to reporting requirements.
Reportable quantity (RQ) = 10 lb.
Threshold planning quantity (TPQ) = 500 lb.

Occupational Safety and Health Administration (OSHA)

Potential occupational carcinogen: Engineering controls, work practices, and personal protective equipment are required.

Guidelines

American Conference of Governmental Industrial Hygienists (ACGIH)

Threshold limit value – time-weighted average (TLV-TWA) = 0.5 ppm.

National Institute for Occupational Safety and Health (NIOSH)

β-propiolactone is listed as a potential occupational carcinogen.

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